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Title of Proposed Observation:

Flow and Magnetic Fields in the Vicinity of Active Region Filaments with GREGOR, VTT, DST, NST, and Hinode

Main Objective:

The main purpose of this observing run is to exploit multi-instrument and multi-telescope data for accurately measuring magnetic and velocity fields in and around the magnetic neutral line of active regions with filaments.

Scientific Justification:

The flow and magnetic fields surrounding an active region (AR) filament play an important role in filament formation, their evolution and disruption. AR filament eruptions are often related to coronal mass ejections (CMEs) (e.g., Low et al. 2001, JGR 106, 25141; Gopalswamy et al. 2003, ApJ 286, 562). CMEs are the most energetic events in the solar system expelling up to 10 13 kg of coronal material from the Sun at speeds of several hundreds to thousands of kilometers per second. Since AR filaments and CMEs are closely connected and the primary cause of space weather disturbances, we need to understand their properties, especially their ultimate origin, precursors, and near-Sun evolution in order to predict them. Filaments are embedded in magnetic fields. Their plasma is sustained against gravity by magnetic field lines. There are several models which aim to explain this phenomenon. The sheared arcade models show sheared field lines below an unsheared coronal arcade (Antiochos et al. 1994, APJL 420, 41) where plasma can be stored. Eventually, reconnection can happen between the sheared and overlying unsheared field lines producing helical field lines (DeVore and Antiochos 2000, APJ 539, 954-963) which are typically called flux ropes. The well-know flux-rope model from van Ballegooijen and Martens (1989, APJ 343, 971-984) attempts to explain how these helical structures are formed in the chromosphere or corona when combining photospheric converging flows and shearing motions at the magnetic neutral line producing reconnection processes. So far, there are only few observations of active region filaments to support the aforementioned models (e.g., Okamoto et al. 2008, APJ 673, L215-L218; Lites et al. 2010, APJ 718, 474-487; Kuckein et al. 2012, A&A 539, A131; Kuckein et al. 2012, A&A 542, A112; Xu et al. 2012, APJ 749, 138). Furthermore, such a study requires simultaneous and coordinated observations of several layers of the Sun, including spectropolarimetry.

Improved measurements of the photospheric and chromospheric three-dimensional magnetic and flow fields are crucial for a precise determination of the origin and evolution of AR filaments. We will carry out such measurements based on high-resolution vector magnetograms and three-dimensional flow field observations. Transverse flow field measurements will be based on speckle reconstructed intensity images. This provides a more realistic approximation of the real plasma velocity fields rather than velocity measurements derived from longitudinal magnetograms. Combining photospheric and chromospheric vector magnetograms (e.g., Yelles Chaouche et al. 2012, APJ 748, 23) will make it possible to understand how AR filaments are formed and how they eventually evolve towards a CME.

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SSC Point of Contact: SOT -- Dick Shine (LMSAL)

Dates:

10 days from 19 September – 30 September 2016

We request Hinode support for 2 hours (coordinating VTT & GREGOR) and 3 hours (coordinating DST & NST - if proposals submitted are accepted) of observing time on 10 days during the time window specified below.

Observations on consecutive days are desired, but not necessary. Like other ground-based HOPs, it requires fairly high priority until some good data is obtained at Tenerife/SacPeak/BBSO, then priority can drop down. We will inform the Hinode team well in advance about the local weather conditions.

Time window:

The best seeing conditions at Tenerife are from 8:30-10:30 UT and at Sac Peak & BBSO are from 14:30-17:00 UT in September.

Continuous observations within that time window are requested to cover the temporal evolution of magnetic and flow fields. However, the time window and its duration are not rigid. We highly appreciate suggestions from Hinode team and will be able to adjust accordingly.

Target(s) of interest:

An active region with a filament and well define magnetic neutral line would be the preferred target. We would prefer to follow the same region for the whole observing campaign, if it matches the above criteria. Observer on site will specify detailed pointing and inform Hinode team every day.

SOT Requests:

SP ~ 460 Mbits/hr, ~2400 Mbits/day

For every hour we request for 3 SP IQUV scan (fast map, for 64" x 123", 0.32" slit, 14 min, 7 min cadence) centered on the magnetic neutral line during the coordinated observation.

EIS Requests:

None.

XRT Requests:

None.

IRIS Requests:

None.

Additional instrument coordination:

VTT - High-resolution spectrograph Two-dimensional spectral data in Hα and Na D2 will provide information on line-of-sight velocities, optical thickness, life-times, and dynamical changes.

----------------- GREGOR HiFI- Sequences of G-band (λ430.7 nm) images will be used to investigate horizontal proper motions, to find associations with small-scale magnetic fields (proxy-magnetometry), and to match the spectroscopic data to observations from space (Hinode and SDO). Along with it we will be taking image sequences in blue continuum (λ450.6 nm). GFPI- We will acquire spectropolarimetric data in the spectral lines Fe I (λ630.2 nm) and Fe I (λ617.34 nm). GFPI data will cover a FOV of 50" x 38" and have a cadence of 30-90 s depending on the setting chose to scan the spectral line (GFPI, Puschmann et al. 2012, AN 333, Issue 9, 880). GRIS- We will use the spectrograph in the 1μm window to obtain all four Stokes IQUV spectral profiles in Si I λ1082.7 nm (photosphere) together with He I λ1083.0 nm (chromosphere).

----------------- Dunn Solar Telescope (DST) - We have requested following settings (decision is still pending) FIRS - Spectral range 10830 A - If possible covering 10827 A Si I (photosphere), 10830A He triplet (chromosphere), and at least one telluric line. IBIS - Narrowband Channel - spectropolarimetric - Ca II 8542 A and spectroscopic - Hα 6563 A -- Broadband Channel - 6820 A ROSA - All four filters New Solar Telescope (NST/BBSO) - We have requested following settings (decision is still pending) (1) Broad-Band Filter Imager (BFI) - G-band (430.5 nm, 5- A bandpass), 55arcsec Field-of-view (FOV) 100 frames every 15 seconds. (2) Near-Infrared Imaging Spectropolarimeter (NIRIS) - He I triplet (1083 nm, chromosphere), 85 arcsec FOV, full-Stokes. If possible, the nearby Si I (1082.7 nm, photosphere) line should be scanned as well. (3) Fast-Imaging Solar Spectrograph (FISS) - H-alpha (656.3 nm) and infrared Ca triplet (854 nm), 40 arcsec × 60 arcsec FOV, 20-second cadence.

Previous HOP information:

HOP0287
- oral presentation in Potsdam Thinkshop, Potsdam, October 2015
- oral presentation in GREGOR meeting, Goettingen, January 2016

Additional Remarks: